Semester – IV
Paper – VI (B) Functional Analysis – II

Unit – I
The Dirac delta function and Delta Sequences: The Heaviside function, The Dirac delta functional the delta sequence, The unit dipole, the Heaviside sequences. (15 Lectures)

Unit- II
Schwartz – Sobolev theory of Distributions: Definitions, Test Functions, Linear Functionals and distributions, Algebraic and Analytic Operations on Distributions, Support and singular support of distribution, Transformation properties, Convergence of distributions. Fourier series (15 Lectures)

Unit- III
Tempered distributions and the Fourier Transforms: The space of rapidly decreasing functions, The spaces of Tempered Distributions, multipliers, Fourier Transform and its properties. (15 Lectures)

Unit- IV
Direct product and convolutions of Distributions: Definition of the direct product, the direct product of tempered distributions. The Fourier Transform of the direct product of tempered distributions, Convolution of the distributions, Fourier Transform. (15 Lectures)

Unit- V
Laplace Transform: Review of classical results, The Laplace Transform of distributions, The Laplace Transform of distributional Derivatives and vice versa. (15 Lectures)

Text Books:

1. R. P. Kanwal: Generalized functions Theory and Technique Academic Press Inc. New York (1983)

2. R. S. Pathak: A course in Distribution Theory and Applications, Narosa Pub. House New Delhi, 2001

3. A. H. Zemanian: Distribution Theory and Transform Analysis McGraw Hill New York (1965)

Semester – IV
Paper – VII (B) Mechanics

Unit – I

Mechanics of system of particles, generalized coordinates, Holonomic & nonholonimic system, Scleronomic & Rheonomic system, D' Alemberts's principle and Lagrange's equation of motion, different forms of Lagrange's equation, Generalized potential, conservative fields and its energy equation, Application of Lagrange's formulation. (15 lectures)

Unit – II

Functionals, Linear functionals, Fundamental lemma of Calculus of Variations simple variational problems, The variation of functional, the extermum of functional, necessary condition for extreme, Euler's equation, Euler's equation of several variables, invariance of Euler's equation, Motivating problems of calculus of variation, Shortest distance, Minimum surface of revolution, Brachistochrone Problem, Isoperimetric problem, Geodesic. (15 lectures)

Unit – III

The fixed end point problem for 'n' unknown functions, variational problems in parametric form, Generalization of Euler's equation to (i) 'n' dependent functions (ii) higher order derivatives. Variational problems with subsidiary conditions, (15 lectures)

Unit – IV

Hamilton's principle, Hamilton's canonical equations, Lagrange's equation from Hamilton's principle Extension of Hamilton's Principle to nonholonomic systems, Application of Hamilton's formulation (Hamiltonian) cyclic coordinates & conservation theorems, routh's procedure, Hamilton's equations from variational principle, The principle of least action. (15 lectures)

Unit – V

Two-dimensional motion of rigid bodies. The independent coordinates of a rigid body, Orthogonal transformations, Properties of transformation matrix, The Euler angles, Cayle-klein parameters & related quantities, Euler's dynamical equation for the motion of rigid body. (15 lectures)

Text Books:

1. H. Goldstein, Charles Poole, John Safko: Classical Mechanics, Pearson 3rd Education, 2002.
   Cha. –1 , Cha. – 2 (2.1 to 2.4), Cha. (8.2-8.6) Cha. 4 (4.1 to 4.6)
2. I. M. Gelfand & S. V. Fomin: Calculus of variations, prentice-Hall.
   Chapter -1 (1,2,3,4,5,6) Chapter –2 (9.10,11,12)

Reference Books:

1. N. Rana and B. Joag: Classical Mechanics, Tata McGraw Hill 1991.
2. F. Gantmacher, Lectures in Analytic Mechanics, NIR Publishing House, New Delhi.
3. A. S. Ramsey, Dynamics Part II, The Engilish Language book Society and Cambridge University Press 1972

Semester – IV

Paper - VIII (B) MATLAB Programming

Unit – I
Introduction: Input / out put of Data from MATLAB Command, file Types, Creating saving and, Executing the Script file, Creating and executing functions file, working with files and directories. (15 Lecturers)

Unit – II
Matrices: Matrix manipulation, creating vectors. Arithmetic operations. Relational operations, Logical operations, matrix functions, Determinant of matrix, Eigen values and Eigen vectors. (15 Lecturers)

Unit – III
Programming in Matlab: function files, sub functions, Global Variables, Loops, branches and control flow, Interactive input, Recursion, Publishing a report, Controlling Command Windows, Command line Editing. (15 Lecturers)

Unit – IV
Linear algebra and Interpolation: solving a linear system, Gaussian elimination, Matrix factorizations, Curve fitting, Polynomial curve fitting, Least squares curve fitting, General nonlinear fits, Interpolation. (15 Lecturers)

Unit – V
Differential equations & Graphics: First order linear ODE, Second order ODE, Double integration, Roots of Polynomial, 2-d plots, 3-D plots, Matlab Plotting tools, Mesh and Surface Plots. (15 Lecturers)

Text Book:

1. Applied Numerical Methods Using MATLAB, Won Young Yang, Tae-Sang chung, John Morris, A John Wiley and Sons. Inc. Publication.
2. Solving ODE's with Maltab, L.F. Shampine, I Gladwell, S. Thompson, Cambridge University Press.
3. Getting Started with MATLAB 7, Rudra Pratap. OXFORD Press.

Reference Books:

1. Brain D. Hahn Dan: essential MATLAB for engineers and Scientists, 3rd Edition Valentine.
2. Gunnar Backstrom: practical Mathematics Using Matlab.
3. Jon H. Davis: methods of Applied Mathematics with a MATLAB Overview.

Semester – IV
Paper - - IX (B) – Fluid Mechanics - II

Unit – I
Viscous flows, stress components in a real fluid, Relation between Cartesian components of stress, translationl motion of a fluid element, rate of strain quadric and principal stresses, properties of the rate of strain quadric, [1]. (15 lecturers)

Unit – II
Stress Analysis in Fluid Motion, relation between stress and rate of strain, the coefficient of viscosity and laminar flow, the Navier Stock's equations, [1]: The energy equation, [2], [3], Equations in Cartesian, cylindrical or spherical polar coordinates for a viscous incompressible fluid: - Statements only without proof; [2] [3], Diffusion of velocity and dissipation of energy due to viscosity, [1].
(15 lecturers)

Unit – III
Some Solvable Problems in viscous flow with heat transfer: - Flow between parallel Plates velocity and temperature distribution [2], [3] steady flow through a tube of uniform circular cross section, Velocity and Temperature Distribution, [2], [3], Distribution, [2], steady flow between concentric rotating cylinders, velocity and temperature distribution, [2],[3], Flow in tubes of arbitrary but uniform cross section, equations for velocity and Temperature in a steady flow, [1], [2], [3] Uniqueness Theorem for the velocity and Temperature , [1], Velocity distribution for tubes having equilateral triangular or elliptic cross section, [1] Velocity distribution for the flow through a tube of rectangular cross section [2], [3].
(15 lecturers)

Unit – IV
Flow between two porous Plates, plane Couett of plane poisseuille flow – velocity and temperature distribution, [2], Flow through a convergent or divergent channel, [2], [3], Flow of two immiscible fluids between parallel Plates, [2], Flow due to a Plane wall suddenly set in motion or due to an oscillating plane wall, [3].
(15 lecturers)

Unit – V
Flows at small or large Reynolds numbers: Dimensional Analysis Non-dimensional form of the Navier Stokes equations, approximate equations for flows at small or large Reynolds numbers, [1], [3], Flows at small Reynolds number: Theory of Lubrication between two plates, [2], [4], Model of a Paint brush, [4], Stoke's flow past a sphere, drag, [1], [3], Flow through a porous slab, [2]
Flows at large Reynolds number: Derivation of the boundary layer equations, [3], Karnans momentum integral equations, [1]. (15 lecturers)

Text Books:

1. F. Chorlton: Textbook of Fluid Dynamics, C.B.S. Pub. Delhi, 1976, Ch. 8
2. R. K. Rathy: An Introduction to Fluid dynamics, I.B.H. Pub. Co, New Delhi 1976,
   (§ 6.5,6.6a to 6.6c, 8.2 to 8.2c, 8.2e, 8.3 to 8.5b, 8.10a, 11.1, 11.2,11.4,11.6,11.9, 11.9a, 119b, 11.10, 11.10a, 12.2, 12.3d,).
3. J. L. Bansal: Viscous Fluid Dynamics, Oxford and IBH Pub. Co. 1977.
   (§ 2.5, 2.6, Tables 2.2, 2.4, 2.6, § 4.2 to 4.7, 4.12, 4.13, 5.1 to 5.3, 5.6, 6.1, 6.2.
4. G. K. Batchelor: An Introduction to Fluid Mechanics, Foundation book New Delhi, 1994, (§ 4.2, § 4.8).

Reference Books:

1. S. W. Yuan: Foundations of Fluid Mechanics Prentice Hall, of India, New Dehli, 1976.
2. W. H. Besaut and A. S. Ramsay: A Treatise on Hydrowecouies part II, CBS Pub. Delhi 1988.
3. A. J. Chorian and A Marsdeu: A Mathematical Introduction to Fluid Dynamics, Springer Verlag New York 1993.
4. L. D. Landau and E. M. Lipschitz: Fluid Mechanics, Press London 1985.
5. H. Schlicating: Boundary layer Tehory McGraw Hill New York, 1979.
6. A. D. Young: Boundary Layer AIAA Education Series, Washington, 1989.

Semester – IV
Paper - X (B) Boundary Value Problems

Unit- I

Preliminaries. Definition of a boundary value problem for an ordinary differential equation of the second order and its reduction to Fredholm integral equation of the second kind. Examples. Dirac Delta Function. Green's function approach to reduce boundary value problems of self- adjoint differential equation with homogeneous boundary conditions to integral equation form. Examples Auxiliary problem satisfied by Green's function (15 lectures)

Unit – II

Integral equation formulation for the boundary value problem with more general and inhomogeneous boundary conditions. Examples. The sturm- Liouville problem Example Modified Green's Functions Examples. (15 lectures)

Unit – III

Integral representation formulas for the solutions of the Laplace and Poisson equations. The Newtonian, single-Layer and double-Layer potentials. Interior and exterior Dirichlet and Neumann boundary value problems for Laplace's equation Examples. (15 lectures)

Unit – IV

Green's function for Laplaces's equation in a free space as well as in a space bounded by a ground vessel. Integral equation formulation of boundary value problems for Laplace's equation. Poisson's integral formula. Green's function for the space bounded by two parallel plates or an infinite circular cylinder.

(15 lectures)

Unit- V

Mixed boundary value problems Two-part and three- part boundary value problems. Perturbation techniques and its applications to mixed boundary value problems. Solutions of electrostatic problems involving a charged circular disk and annular circular disk and spherical cap an annular spherical cap in a free space or a bounded space. (15 lectures)

Text Book:

1. R. P. Kanwal, Linear Integral Equations. Theory and Technique. Academic Press New York 1971
   Arts: 5.1 to. 5.6, 5.8, 5.9, 6.1 to 6.5 10.1, 10.2, 11.1,11.2

Reference books:

1. S. G. Mikhlin, Linear Integral Equations (translated from Russian) Hindustan Books Agency 1960
2. I. N. Seneddon, Mixed boundary Value Problems in Potential Theory, North Holland 1966.
3. I Stakgold, Boundary Value Problems of Mathematical physics Vol. I and II Macmillan 1961.

Semester – IV
Paper - XI (B) - Fuzzy Mathematics

Specific objectives: To introduce the theory of fuzzy sets as a measure of uncertainty and a ambiguity. Also to introduce fuzzy and fuzzy logic and different operations on them.

Unit – I

From classical (crisp) sets to fuzzy sets; Introduction: crisp sets: An overview; Basic concepts in fuzzy sets; convex fuzzy sets (Theorems and exercises)

(15 lectures)

Unit – II

Fuzzy sets versus crisp sets: Additional properties of α - cuts; Representation of fuzzy sets; Decomposition Theorems. Operations on Fuzzy sets;
Types of operations; Fuzzy complement (Axioms and theorems)

(15 lectures)

Unit – III
Fuzzy intersections: t- norms; fuzzy unions: t – co norms; Combinations of operations; Aggregation of operations. (15 lectures)

Unit – IV
Fuzzy Arithmetic: fuzzy numbers; Linguistic Variables; Arithmetic operations on intervals of real numbers; Arithmetic operations on fuzzy numbers. (15 lectures)

Unit – V
Fuzzy relations: Introduction; fuzzy Relations; operations on fuzzy relations; α - cuts of a fuzzy relation; composition of fuzzy Relations; fuzzy relation on a domain.
Fuzzy Logic: Introduction; three valued logic; Infinite valued logic; fuzzy proposition and their interpretations in terms of fuzzy sets. Fuzzy rules and their interpretations in terms of fuzzy relations. (15 lectures)

Text Books:

1. Unit (I-IV) is covered by Klir George J. and Yuan Bo, Fuzzy sets and fuzzy logic. Theory and applications. Prentice Hall of India Pvt. Ltd. New Delhi. 1997.
2. M. Ganesh, Introduction to Fuzzy sets and Fuzzy logic, (OHI), New Delhi, 2006.

Reference books:

1. Kaufmann A and Gupta M. M., Introduction to Fuzzy arithmetic, Van Nostrand.
2. Zimmermann H. J., Fuzzy set theory and its applications, 1997.

Semester – IV
Paper- XII (B) Linear Algebra

Unit 1 :
Vector spaces, subspaces, linear dependence, independence, basis and dimension of a vector space. (15 Lectures)

Unit 2 :
Rank of a matrix, change of a basis, Linear transformations, algebra of linear transformations, range space, kernel space, rank of a linear transformation. (15 Lectures)

Unit 3 :
Algebra of linear transformations, Matrix representation of a linear transformation, dual spaces. (15 Lectures)

Unit 4 :
Eigen values, eigen vectors, Cayley – Hamilton theorem Minimal polynomials.
(15 Lectures)

Unit 5 :
Canonical forms **,** Diagonal form , triangular form, Jordan form
Introduction to Quadratic forms. (15 Lectures)

Recommended Books :

(1) Linear Algebra by Surjit Singh, Vikas Publishing House, New Delhi.
(2) Linear Algebra by Vivek Sahai and Vikas Bist, Narosa Publishing House. New Delhi.
(3) Linear Algebra by K. Hoffman and Ray Kunze (Second edition) Prentice Hall of India, New Delhi.
(4) Linear Algebra by S. H. Friedberg, A. J. Insel and L. E. Spence, Prentice Hall of India, New Delhi.
(5) Linear Algebra and its applications David C. Lay, Pearson Education.
(6) Linear Algebra by G. Paria, New central Book agency, Calcutta.

Semester. IV

PAPER XIII (B): ADVANCED FUNCTIONAL ANALYSIS – II

Linear Varieties and Hyperplanes. Geometric form of Hahn-Banach theoem. Uniform-boundedness principle. Open mapping theorem and closed graph theorem for Frehet spaces. Banac-Alaoglu theorem.

Extreme points and Extremal sets. Krein-Milman's theorem.

Duality,Polar. Bipolar theorem. Baralled and Bornological spaces. Macekey; Spaces. Semireflexive and Reflexive topological vector spaces. Montel Spaces and Schwarz spaces. Quasicompleteness. Inverse limit and inductive of locally convex spaces.

Reference Books:

1. John Horvath, Topological Vector spaces and Distributions, Addison-Wesley Publishing Company, 1966.
2. J.L. Kelley and Isaac Namioka, Linear Topological Spaces, D. Van Nostrand Company, Inc, 1963.

Semester. IV

PAPER XIV (B): ADVANCED THEORY OF PARTIAL DIFFERENTIAL EQUATIONS - II.

Calculus of variations-Euler-Lagrange Equation. Second Variation. Existence of Minimizers (Coercivity, Lower Semi-continuity, convexity). Regularity. Constraints (Nonlinear Eigenvalue Problems. Variational Inequalities. Harmonic Maps. Incompressibility). Critical Points (Mountain Pass Theorem and Applications to Elliptic PDE).

Nonvariational Methods-Monotonicity Methods. Fixed Point Theorems Sub and Super Solutions. Geometric Properties of Solutions (Radial Symmetry),. Nonexistence of Solutions. Gradient Flows.

Hamilton-Jacobi Equations-Viscosity Solutions. Uniqueness. Control Theory, Dynamic Programming.

Systems of Conservation Laws-Integral solutions. Travelling Waves. Hyperbolic Systems. Riemann's Problem. Systems of Two Conservation Laws. Entropy Criteria.

Reference Books:

1. S. Kesavan, Topics in Functional Analysis and Applications, Wiley-Eastern, New Age International, 1989.
2. L,C. Evans. Partial Differential Equations, Graduate Studies in Mathematics, Volume 19, AMS, 1998.

Semester. IV

PAPER XV(B): THEORY OF ORDINARY DIFFERENTIAL EQUATIONS II

Differential systems involving linearly a parameter –Formulation of the problem. Elementary properties of boundary value problems. Properties ;of the Green's matrix, Boundary problems involving an n-th order linear vector differential equation. Self-adjoint boundary problems. Definite boundary problems.

Second order linear differential equations-Introduction, preliminary properties of solutions. An associated functional. The associated Riccati differential equation. Oscillation criteria. Comparison theorems. Differential systems involving a real parameter. Fundamental quadratic; forms for conjugate and focal points.

Recommended Text.

W.T. Reid, Ordinary Differential Equations. John Willey & Sons, NY (1964)

Reference Books:

1. Philip Hartman, Ordinary Differential Equatins, Jhohn Wiley & Sons, NY (1964)
2. E. A. Coddington and N. Levinsion. Theory of Ordinary Differential Equations, McGraw-Hill, NY (1955).

Semester – IV
Paper – XVI – (B) Difference Equations - II

Unit- I
Self adjoint second order linear equations Introduction. Sturmian Theory, Green's functions disconjugacy. The Riccati equations. Oscillations. (15 Lectures)

Unit- II
The Sturm-Liouville problem Introduction, finite Fourier Analysis non-homogeneous problem (15 Lectures)

Unit- III
Discrete calculus of variations Introductions, Necessary conditions, sufficient conditions and Disconjugacy. (15 Lectures)

Unit- IV
Boundary value problems for Nonlinear Equations-Introduction. The Lipschite case. Existence of solutions boundary value problems for Differential Equations. (15 Lectures)

Unit- V
Partial Differential Equations: Discrimination of partial differential equations. Solutions of partial differential equations. (15 Lectures)

Text Book:

1. Walter G. Kelley and Allan C. Peterson: difference Equations – An Introduction with applications. Academic Press, Harcourt Brace Jouranovich Pub. 1991.

Reference book:

Calvin Ahlbrandt and Allan C. Peterson: Discrete Hamiltonian systems Difference equations, continued fractions and riccati Equations, Kulwer, Boston 1996.

Semester – IV
Paper – XVII (B) Computational Fluid Dynamics – II

Unit - I
Iterative Methods-Stationary Methods. Krylov Subspace Methods. Multigrid Methods. Fast Poison Solvers. Iterative Methods for Incompressible NS Equations. (15 Lectures)

Unit- II

Shallow water Equations-One and Two Dimensional Cases. Scalar Conservation Laws-Godunov's Order Barrier Theorem, Linear schemes. (15 Lectures)

Unit - III
Euler Equation in One space Dimension-Analytic Aspects, Approximate Riemann Solver Osher Scheme. Flux Splitting Schemes. Stability. (15 Lectures)

Unit – IV
James-Schmidt-Turkel Scheme. Higher Order schemes. Discretization in General Domains- Boundary Fitted Grids. Equations of Motion in General Coordinates. (15 Lectures)

Unit - V
Numerical Solution of Euler Equation in General Coordinates. Numerical Solution of NS Equations in General Domains. Unified Methods for Computing Compressible and Incompressible Flow. (15 Lectures)

Text Book:

1. P. Wesseling, Principles of Computational Fluid Dynamics, Springer-Verlag, 2000.

Reference Books:

1. J. F. Wendt. J.D. Anderson, G Degrez and E. Dick, Computational Fluid Dynamics: An Introduction, Springer -Verlarg 1996.
2. J.D. Anderson. Computational Fluid Dynamics: The Basics with Applications, McGraw-Hill, 1995.

Semester. IV
PAPER XVIII(B): ALGEBRAIC CODING THEORY -II

Tree Codes. Convolutional Codes. Descriptionn of Linear Tree and Convolutional codes by Matrices. Standard array. Bounds on minimum distance for convolutional Codes. V.G.S. bound. Bounds for burst-Error detecting and Correcting Convolutional Codes. The Lee metric, packing bound for Hamming

Code w. r. t. Lee metric. The Algebra of Polynomial residue Classes. Galois Fields. Multiplicative group of a galois field. Cyclic Codes. Cyclic Codes as ideals. Matrix Description of Cyclic Codes. Hamming and Golay Codes as Cyclic codes. Error Detection with Cyclic codes. Error-Connection procedure for Short Cyclic Codes Short-ended Cyclic Codes. Pseudo Cyclic Codes. Code Symmetry. Invariance of Codes under transitive group of permutations. Bose-Chaudhary-Hocquenghem (BCH) Codes. BCH bounds. Reed-Solomon (RS)Codes.Majority-Logic Decodable Codes. Majority-Logic Decoding. Singleton bound. The Griesmer bound Maximum-Distance Separable (MDS) Code. Generator and Parity-check matrices of MDS Codes. Weighty Distribution of MDS code. Necessary and Sufficient conditions for a linear code to be an MDS Code. MDS codes from RS codes. Abramson Codes. Closed-loop burst-error correcting codes (Fore codes). Locating Codes.

Reference Books:

1 Raymond Hill, A first Course in Coding Theory, Oxford, 1986.
2 Man Young Rhee, Error Correcting Coding Theory, McGraw Hill, 1989.
3 W.W. Peterson and E.J. Weldon, Jr. Error-Correcting Codes. M.I.T. Press, Cambridge Massachusetts. 1972.
4 E. R. Berlekamp, algebraic Coding Theory, McGraw Hill Inc., 1968.
5 F. J. Macwilliams and N.J.A. Sloane, Theory of Error Correcting Codes, North-Holand Publishing Company, 1977.

Semester. IV
PAPER XIX(B): ALGEBRAIC TOPOLOGY -II

Mayer Vietoris sequence (with proof) and its application to calculation of homology of graphs, torus and compact surface of genus g, collared pairs, construction of spaces by attaching of cells, spherical complexes with examples of S^n, r-leaved rose, torus, RP^n, CP^n ,S^2 x S^2, X+Y etc.

Singular cohomology modules, Kronecker product, connecting homomorphism, contrafunctoriality of singular cohomoloty modules, naturality of connecting homomorphism, exact cohomlogy sequence of pair, homotopy invariance, excision properties, cohomology of a point. Mayer Vietoris sequence and its application in computation of cohomology of S^n, RP^n, CP^n, torus, compact surface of genus g and; non-orientable compact surface.

Compact connected 2-manifolds. Thir orientability and non-orientability, examples, connected sum, construction of projective space and Klein's bottle from a square, Klein's bottle as union of two Mobius strips, canonical form of sphere, torus and projective planes. Kelin;s bottle. Mobius strip triangulation of compact surfaces.

Classification theorem for compact surfaces, connected sum of torus and projective plane as the connected sum of three projective planes, Euler characteristic as a topological invariant of compact surfaces. Connected sum

formula, 2-manifolds with boundary and ;their classifications, Euler characteristic of a bordered surface, models of compact bordered surfaces in R^3

Reference Books:

1 James R. Munkres, Topology-A first Course, Prentice Hall, New Delhi,1978
2 Marwin J. Greenberg and J.R.Harper algebraic Topology-A first Course, Addison-Wesley Publishing Co. 1981.
3 W.S. Nassey Algebraic Topology-An Introduction, Harcourt, Brace and World Inc. 1967, SV., 1977.

Semester – IV
Paper – XX (B) Operations Research - II

Unit - I
Sequencing, problems with n jobs and two machines, problems with n jobs and three machines, graphical method, n jobs and m machines. (15 lectures)

Unit - II
Dynamic programming, computational procedure, solution of LPP by dynamic programming. (15 lectures)

Unit - III
Nonlinear Programming introduction, general nonlinear programming problems, problem of constrained maxima and minima, graphical solution Kuhn-Tucker conditions, Quadratic programming. Integer programming (15 lectures)

Unit - IV
Replacement problems, Applications to industrial problems. (15 lectures)

Unit - V
Network scheduling and PERT CPM. (15 lectures)

Text book:
Kantiswarup and others Operations Research.
Chapter - 10,11,12 (sections 12.1 to 12.3),13 (sections 13.1 to 13.3), 14 (sections 14.1 to 14.5), 18 (sections 18.1 to 18.3),19. (Sections 19.1 to 19.8)

Reference Books:

1. H. A. Taha: Operations Research- An introduction, Macmillan, New York,
2. S.S. Rao: Optimization Theory and Applications, Wiley, New Delhi.
3. N. S. Kambo, Mathematical-programming Techniques. Affiliated East-West Press, New Delhi.

Semester. IV
PAPER XXI (B): BANACH ALGEBRAS -II

Strong and weak operator topologies. Von Neumann Algebras. Monotone Sequence of Operators. Range Projections. The Commutant Theorem.
The Kaplansky Density Theorem L as Von Neumann Maximal Abelian Algebras
Abelian Von Neumann Algebras. Cyclic and separating vectors. Representation of Abelian Von Neumann Algegbras . The L functional calculus. Connectedness of the Unitary Group. The projection lattice. Kaplansky's formula.The centre of a Von Neumann Algebras. Various types of .projections Centrally Orthogonal projections, type Decomposition.

Reference Books:

1 Kehe Zhu., An introduction to Operator Algebras-CRC Press Inc. l993.
2. W. Arveson, Introduction to C*algebras, Springer-Verlag, 1976.
3. F.F. Bonsall and J. Duncan, Complete normed algebras, Springer- Verlag, 1973.
4. J. Dixmier, C* algebras, North Holland, Amsterdam, 1977.
5. R.V. Kadison and J.R. Ringrose, Fundamentals of Operator Theory, Vols. I and II Academic Press, (l983 and l986).
6. A. Naimark , Normed Algebras. Noordhoff, Grioningen. 1972.
7. T.W. Palmer, Banach Algebra Vol. I. Cambridge University Press l994.
8. C.E. Rickart, General Theory of Banach Algebras. Von Nostrand l960.
9. M. Takesaki: Theory of Operator Algebras I, Springer Verlag, 1979.

Semester. IV
PAPER XXII(B): WAVELETS - II

Frames- The reconstruction formula and the Balian-Low theorem for frames. Frames from translations and dilations. Smooth frames for $H^2 R$).
Discrete transforms and algorithms- The discrete and the fast Fourier transforms. The discrete and the fast cosine transforms. The discrete version of the local sine and cosine bases.

Recommended text.

1. Eugenio Hernandez and Guido Weiss, A first Course on Wavelets,. CRC Press, New York, 1996.

Reference Books:

1. C. K. Chui, An Introduction to Wavelets, Academic Press, 1992.
2. I. Daubechies, Ten Lectures on Wavelets. CBS-NSF Regional Conferences in Applied Mathematics, 61, SIAM. 1992.

3. Y. Meyer, Wavelets. Algorithms and applications (translated by R.S. Rayan. SIAM. 1993.
4 M. V. Wickerhauser, Adapted wavelet analysis from theory to software, Wellesley, MA, A. K. Peters, 1994.

Semester. IV
PAPER XXIII (B): FUNDAMENTALS OF APPLIED FUNCTIONAL ANALYSIS II

Semigroups of linear operators-General properties of Semigiroups. Generation of semigroups. Dssipative semigroups.Compact semigroups. Holomorphic semigroups. Elementary examples of semigroups. Extensions. Differential equations. Cauchy Problem. Copntrollabaility. State reduction. Observability. Stability and Stabili\ability. Evolution equations.

Optional Control theory-Linear quadratic regulator problem. The same problem with infinite time interval. Hard Constraints. Final Value Control Time Optimal Control Problems.

Recommended Text.

A. V. Balakrishnan, Applied Functional Analysis, Springer-Verlag, New York, Inc.

Reference Books:

1 N. Dunford and J.T. Schwartz, Linear Operators,Vls. I & II Inter science, New York 1958, 1968.
2. S. G. Krein, Linear Differential Equations in a Banach Space, American Mathematical Society, Translation, 1970.
3. K. Yosida, Functional Analysis, Springer-Verlag, 1974.

Semester. IV
PAPER XXIV (B): ALGEBRAIC NUMBER THEORY -II

Cyclotomic fields, roots of unity, Class group and the finiteness of the class number. Dirichlet uni t theorem, Pell's equation, Dedekind and Riemann zeta functiion, analytic class number formula.

Reference Books:

1 S. Lang, Algebraic Number Theory, GTM Springer-Verlag,1994.
2 J.P. Serre, Local Fields. GTM Vol. 67 , S. pringer-verlag, 1979.
3 J. Esmonde, and M. Ram Murty, Problems in Algebraic Number Theory, GTM Vol. 190, Aspringer-Verlag-1999.

Semester IV
Paper XXV (B) Combinatories II

Unit - I
Counting Methods for selections arrangements Basic counting principles, simple arrangements and selections, arrangements and selections with repetition, distributions, binomial, generating permutations and combinations and programming projects. (15 lectures)

Unit – II
Generating function: Generating function models, calculating of generating functions, partitions, exponential generating functions, a summation method. (15 lectures)

Unit - III
Recurrence Relations: Recurrence relation model, divide and conquer relations, solution of inhomogeneous recurrence relation, solution with generating functions. (15 lectures)

Unit – IV
Inclusion-exclusion Counting with venn diagrams, inclusion formula, restricted positions and rook polynomials. (15 lectures)

Unit – V
Ramsey Theory: Remsey theorem, applications to geometrical problems (15 lectures)

Text Books:

1. Alan Tucker, Applied Combinatorics (third edition), John Wiley & sons, New York (1995)
2. V. Krishnamurthy, Combinatorial, Theory and Applications, East West Press, New Delhi (1989)

Reference Books:

1. J. Marshall Hall Jr., combinatorial Theory, 2nd edition, Wiley Inter Science Publications
2. John Riorden: An Introduction to combinatorial Analysis, Wiley Publications.
3. Chen Chuan-Chang and Koh Khee-Meng, Principles and techniques in Combinatories world Scientific, (1996)

Semester. IV - Paper XXVI - (B): REACTION DIFFUSION THEORY - II

Unit – I

Equations with Nonlinear Boundary Conditions. Parabolic Boundary-Value Problems. An Application to the Linear Problem. Elliptic Boundary-Value Problems. (15 Lectures)

Unit - II

Existence Theorems for Holder-Continuous Functions. Uniqueness of Positive Solution. Applications. (1) A Heat –conduction Problem. (2) A model from Fermentation. (3) A Gas-Liquid Interaction Problem. (15 Lectures)

Unit – III

Stability Analysis. Lyapunov Stability. Stability of Uniform Steady-State Solutions. Stability of Non uniform Steady-State Solutions. (15 Lectures)

Unit – IV

Monotone Convergence of Time-Dependent Solutions. Stability of Maximal and Minimal Solutions. Problems with Nonlinear Boundary Conditions. (15 Lectures)

Unit - V

Application to Models with Nonlinear Reaction Functions. (1) Enzyme Kinetic Models. (2) Models in Population Dynamics. (3) Models in Reactor Dynamics and Heat Conduction. (4) Chemical Reactor Model. Application to Models with Nonlinear Boundary Conditions. (15 Lectures)

Text Book:

[1] C.V. Pao; Nonlinear Parabolic and Elliptic Equations; Plenum Press, New York and London, 1992.

Chapter 4, Articles 4.1, 4.2, 4.4, 4.5, 4.6 and 4.8.
Chapter 5, Article 5.1 - Article 5.8,

Reference Books:

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